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(54) Name of the invention: Manufacturing Method or the Preparation of Cell barriers for Plasma Display Panels

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Patent Assignee: Dai Nippon Ink Company

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[Note : Names, addresses, Company names and brand names are translated in the most common manner. Japanese Language does not have singular or plural words unless otherwise specified with numeral prefix or general form of plurality suffix. Translator's note.]

(54) [Name of the invention]

Manufacturing Method for the Preparation of Cell Barrier for Plasma Display Panel

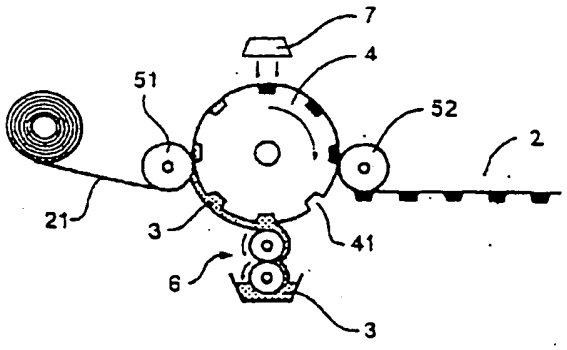
(57) [Summary] [There is an amendment]

[Goal]

The goal of the present invention is to manufacture simply, expediently and stably and with a good precision a cell barrier with any type of shape.

[Structure]

According to the technological process for the preparation of cell barriers for plasma display panel, that is formed as the front surface plate and the back surface plate, that is equipped with a cell barrier which has a structure formed from a number of vacant spaces used for electrical discharge, are positioned so that they are oriented in mutually parallel directions, the intaglio 4 with a formed intaglio part 41 that has a printing surface corresponding to the shape of the cell barrier part, and in the intaglio part, a glass frit containing, ionization radiation curable resin material is filled and together with that the film substrate material 21 is contacted, and as these are in contact, by using ionization radiation irradiation, the ionization radiation curable resin material is cured (hardened), and after that the film substrate and the ionization radiation curable resin are separated from the indented part, and by on the surface of the substrate plate and on the surface of the film substrate material the front surface of the cured ionization radiation curable type resin layer, that has a shape of the cell barrier part, is adhered, and after that it is sintered.



[Range of the claims of the invention]

[Claim 1]

Manufacturing method for the preparation of cell barriers for plasma display panel, that is formed as the front surface plate and the back surface plate, that is equipped with a cell barrier which has a structure formed from a number of vacant spaces used for electrical discharge, are positioned so that they are oriented in mutually parallel directions, characterized by the fact that it is a manufacturing method for the preparation of cell barriers for plasma display panel, that consists of the following. A technological process where an intaglio, with a formed intaglio part, that has a printing surface corresponding to the shape of the cell barrier part, is used, and at least in the intaglio part of the intaglio, a glass frit containing, ionization radiation curable resin material is filled and together with that the film substrate material is contacted, and as these are in contact, by using ionization radiation irradiation, the ionization radiation curable resin material is cured (hardened), and after that the film substrate and the ionization radiation curable resin are separated from the indented part. A technological process where on the surface of the substrate plate and on the surface of the film substrate material, the front surface of the cured ionization radiation curable type resin layer, that has a shape of the cell barrier part, is adhered, and after that it is sintered.

[Detailed explanation of the invention]

[0001]

[Technological sphere of application]

The present invention is an invention about the manufacturing method for the preparation of a cell barrier of plasma display panel (here below called PDP), that is formed as it is equipped with a number of empty spaces for electrical discharge that

are formed by this cell barrier.

[0002]

[Previous technology]

In the past, as the manufacturing method for the preparation of PDP cell barrier, the method has been successfully used where on a glass substrate plate, a glass paste is patterned by using a screen printing method, and then it is sintered. However, in order to obtain the height that is necessary for the cell barrier, the printing and drying has been repeated, and by that a laminated layer has been obtained, and that is how it has been conducted. Also, in order to increase the precision of this barrier shape, the method has been also suggested where on the glass substrate plate, on the part where the cell barrier is to be provided, a lipophilic type macromolecular layer, is provided (Japanese Patent Application Laid Open Number Hei-Sei 5-166460), etc.

[0003]

[Problems solved by the present invention]

In the case of the manufacturing methods according to the previous technology, the manufacturing equipment is not special and the technological processes are easy, however, on the other hand, there are the problems that there is the point that the number of the technological processes is large, and also, together with the increase of the number of the repeats of the screening process, there are the drawbacks that there are deviations in the shape of the barriers and deviations in the printing test, and there is a deviation in the shape from the predetermined shape. And because of that,there has been the problem that it has been said that it is difficult to obtain a high accuracy image.

[0004]

Then, in the case of the present invention, it is an invention that has as a goal to resolve such problems according to the previous technology, as those described here above, and it has as a goal to suggest a new manufacturing method where a good precision cell barrier, is obtained by a simple, and fast and also stable manufacturing.

[0005]

[Measures in order to solve the problems]

In order to achieve the above described goals, the manufacturing method for the preparation of a cell barrier of plasma display panel, according to the present invention, is characterized by the fact that it is a manufacturing method for the preparation of cell barriers for plasma display panel, that is formed as the front

surface plate and the back surface plate, that is equipped with a cell barrier which has a structure formed from a number of vacant spaces used for electrical discharge, are positioned so that they are oriented in mutually parallel directions, characterized by the fact that it is a manufacturing method for the preparation of cell barriers for plasma display panel, that consists of the following technological processes. A technological process where an intaglio, with a formed intaglio part, that has a printing surface corresponding to the shape of the cell barrier part, is used, and at least in the intaglio part of the intaglio, a glass frit containing, ionization radiation curable resin material is filled and together with that the film substrate material is contacted, and as these are in contact, by using ionization radiation irradiation, the ionization radiation curable resin material is cured (hardened), and after that the film substrate and the ionization radiation curable resin are separated from the indented part. A technological process where on the surface of the substrate plate and on the surface of the film substrate material, the front surface of the cured ionization radiation curable type resin layer, that has a shape of the cell barrier part, is adhered, and after that it is sintered.

[0006]

Here below, the practical implementation examples according to the present invention, will be explained based on the diagrams shown. Figure 1 represents a diagram in order to explain the technological processes showing one practical example according to the present invention. In the figure, 1 represents the cell barrier, 2 represents the film substrate material that contains the cell barriers, 3 represents the glass frit containing ionization radiation curable type resin material, 4 represents the roll intaglio, 41 represents the intaglio part, 51 represents the pressing roll, 52 represents the separation roll, 6 represents the coating equipment, 7 is the ionization radiation equipment, 8 represents the glass substrate plate. According to the method of the present invention, first, in the beginning, the roll intaglio 1 is prepared, that takes the shape of the intaglio part 4, which consists of the shape that is used for the shaping of the PDP cell barrier part. For example, the shown according to the diagram equipment is used. Regarding 5 and 6 in the figure, they are the pressure roll and the transport roll, that are positioned opposite to the roll intaglio 1, and for both rolls a clearance adjustment, etc., is possible.

[0007]

After that, relative to the above described intaglio roll 1, the film substrate material 21 is supplied by appropriate measures, so that it is in contact relative to the above described intaglio surface. And at the same time, a glass frit containing ionization radiation curable type resin material 3 is supplied by appropriate means in order to fill at least into the intaglio part of the intaglio 1. Then, the substrate material 2 is made to come in contact with the intaglio 1 and at that time, the ionization radiation curable resin material, is irradiated by an ionization radiation beam that is irradiated from the ionization radiation beam radiating equipment 7, and the

ionization radiation curable resin material that is present in the space between the substrate material 2 and the intaglio 1, is cured, and at the same time, it is adhered onto the side of the substrate material. And finally, the substrate material 2 is separated from the intaglio 1. By the separation of this substrate material 2, as it is shown according to Figure 2, the cell barriers 8, that are shaped on the roll intaglio 1, are formed on the surface of the substrate material 2. And after that, on the front surface of the glass substrate plate the surface of a cured layer of ionization radiation curable type resin, that has the shape of the cell barriers on the surface of the above described film substrate material, was adhered, and after that, it is sintered. And by that, the PDP cell barrier according to the method of the present invention, as it is shown according to Figure 3, is obtained. According to the present invention, the manufacturing o the PDP, that has the cell barriers 8, is conducted according to the above described measures, and because of that, cell barriers with extremely good precision are obtained, as the shape that is shaped on the roll intaglio is faithfully reproduced.

[0008]

Then, regarding the shape of the intaglio part 4 of the above described roll intaglio 1, it can be obtained by using measures such as electron engraving, etching method, the mill pushing, the electrotyping method etc. And also, regarding the shape of the intaglio part 4, it is a shape that is used in order to shape the shape of the cell barriers, and practically, the indented shape part becomes shaped like the cell barrier shape.

[0009]

Regarding the cell barriers 8 of the PDP that must be manufactured according to the present invention, they have the function of forming the space used for the electrical discharge, and it is preferred that they have an oblong elliptic shape, a trapezoid shape, or a rectangular shape. In the case of a oblong eliptic shape or a trapezoid shape, the cell barriers on the side of the back surface are wider than the cell barriers on the front surface side, and because of that, it is possible to make the surface area of the front surface of the cell barriers of the part that is joined with the front surface plate, small. And also, there are the merit points that, because it is physically tough, the brightness is increased, and also, it is possible to form a cell barrier that can resist the vacuum pressure at the time of the plasma light generation, and because of that it is a preferred option. Then, regarding the horizontal plane shape of the cell barriers, it is possible to use lattice shaped cells. However, naturally, according to the present invention, it is also possible to have shapes of the barrier cells, that are outside of the above described conditions.

[0010]

Moreover, regarding the supply and filling of the ionization radiation curable resin

material, as it is shown according to this practical implementation example, it can be conducted as it is directly supplied onto the roll intaglio, by using a roll coating method, or besides that, it is also a good option if it is supplied as prior to the contact of the film substrate material 2 to the roll intaglio 1, it is coated and formed in advance on the surface of this film substrate material, by using a roll coating method etc., and these are supplied. Also, it is a good option if a flat surface intaglio is used, where the printing surface is not limited to the roll intaglio.

[0011]

Also, as the used according to the present invention, ionization radiation curable resin material, polymers, prepolymers, or monomers, that undergo a crosslinking polymerization reaction and are solidified, by the effect of an ionization radiation, can be used. In more details, radical polymerization type, as (meth)acrylamide, (meth)acrylonitrile, (meth)acrylic acid, (meth)acrylic acid ester, etc., (meth)acryloyl radical containing compounds (here, (meth)acryloyl has the meaning of acryloyl or methacryloyl. And here below, it has the same meaning.), epoxy, cathionic polymeric type that are formed from the combination of cyclic ethers, cyclic acetal, lactone, vinyl monomer, cyclic siloxane and aryl diazonium salts, diaryl iodonium salts, thiol radical containing compounds, for example, polyen / thiol type compounds formed from trimethylol propane trithioglycolate, trimethylol propane trithiopropionate, pentaerithritol tetrathioglycolate and polyen compounds.

[0012]

As a monofunctional monomer of the radical polymerization type (meth)acrylate compounds, for example, there are the following: methyl (meth)acrylate, ethyl (meth)acrylate, butyl (meth)acrylate, methoxy ethyl (meth)acrylate, methoxy butyl (meth)acrylate, butoxy ethyl (meth)acrylate, 2-ethyl hexyl (meth)acrylate, N, N - dimethyl aminomethyl (meth)acrylate, N, N- dimethylaminoethyl (meth)acrylate, N, N - diethyl aminoethyl (meth)acrylate, N, N - diethyl amino propyl (meth)acrylate, N, N - dibenzyl amino ethyl (meth)acrylate, lauryl (meth)acrylate, isobornyl (meth)acrylate, ethyl carbitol (meth)acrylate, phenoxy ethyl (meth)acrylate, phenoxy polyethylene glycol (meth)acrylate, tetrahydroxy furfuryl (meth)acrylate, methoxy tripropylene glycol (meth)acrylate, 2- (meth)acryloyl oxy ethyl - 2- hydroxy propyl phthalate, 2 - (meth) acryloyl oxy propyl hydrogen phthalate, etc.

[0013]

Also, as the radical polymerization type polyfunctional monomers, for example, it is possible to use the following: ethylene glycol di (meth)acrylate, diethylene glycol di (meth)acrylate, triethylene glycol di (meth)acrylate, propylene glycol di (meth)acrylate, dipropylene glycol di (meth)acrylate, neopentyl glycol di (meth)acrylate, 1, 6- hexyl diol di (meth)acrylate, 1, 9- nonane diol di (meth)acrylate, tetraethylene glycol di (meth)acrylate, tripropylene glycol di (meth)acrylate, bis

phenol A - di (meth)acrylate, trimethylol propane tri (meth)acrylate, trimethylol propane ethylene oxide tri (meth)acrylate, pentaerithritol tri (meth)acrylate, pentaerithritol tetra (meth)acrylate, dipentaerithritol penta (meth)acrylate, dipentaerithritol hexa (meth)acrylate, glycerine polyethylene oxide tri (meth)acrylate, tris (meth)acryloyl oxy ethyl phosphate etc.

[0014]

Also, as the radical polymerization type prepolymers, for example, it is possible to use the following: alkyd (meth)acrylate, urethane (meth)acrylate, epoxy (meth)acrylate, polyester (meth)acrylate, polybutadiene (meth)acrylate, etc., (meth)acrylate type, unsaturated polyesters etc.

[0015]

Among these compounds containing (meth)acryloyl radical, especially, for the acryloyl radical containing compounds, namely, for the acrylates, the polymerization reaction is faster. And because of that, in the case when the coating and forming of the ionization radiation curable resin material layer, is seriously considered, the speed of manufacturing, the acrylates are preferred over the methacrylates.

[0016]

Then, as the radical polymerization type ionization radiation curable resin material, the above described compounds, can be used as a mixture of two or more compounds, depending on the requirements. And also, it is a good option if the total amount of the (meth)acryloyl radical in the mixed composition is in the range of 0.2 ~ 12 mml/g, and preferably in the range of 2 ~ 10 mmol/g.

[0017]

Then, here, in the case of the ultra-violet curing, as the light polymerization initiating agent, benzoin, benzoin methyl ether, acetophenone, benzophenone, Michler's ketone, biphenyl sulfide, dibenzyl disulfide, diethyl oxide, triphenyl diimidazole, isopropyl - N, N - dimethyl aminobenzoate, etc., can be used, and these can be used individually or as mixtures of two or more types, and they can be mixed in amounts that are in the range of 0.1 ~ 10 weight parts relative to 100 weight parts of the above described ionization radiation curable resin material.

[0018]

Then, here, in the composition material that contains the above described ionization radiation curable resin material, as a solvent agent that is used to dissolve the above described ionization radiation curable resin material, and to

adjust its viscosity etc., to maintain and support its coatability properties, it is possible to use ethyl acetate, propyl acetate, celosolf acetate, etc., ester type, acetone, methyl ethyl ketone, ethyl isobutyl ketone, etc., ketone types, methyl alcohol, ethyl alcohol, isopropyl alcohol, etc., alcohol type, etc., solvents, where it is possible to use these individually as one type of solvent, or it is possible to mix them freely and use two or more types of solvents.

[0019]

As the ionization radiation beam, it is possible to use visible light beam, ultraviolet beam, X rays, electron beam, etc., electromagnetic waves or particulate beams. From a practical point of view, the mainly used radiation are the ultraviolet radiation and the electron beam radiation. As the ultraviolet radiation source, it is possible to use high pressure mercury lamp, ultra-high pressure mercury lamp, low pressure mercury lamp, carbon arc, black light, metal halide lamp, etc., light sources.

[0020]

As the source of the electron beam radiation, it is possible to use the Cockcroft - Walton type, the Van de Graaf type, the resonant transformer type and the insulated core transformer type, or it is possible to use the different types of electron beam accelerator devices, like the linear type, the Dynamitron type, and the high frequency type, and it is possible to use sources that irradiate electrons that have an energy that is in the range of 100 ~ 1000 keV, and preferably, that is in the range of 100 ~ 300 keV. regarding the amount of the irradiation, usually, it is in the range of 0.5 ~ 30 Mrad.

[0021]

Moreover, as the radiation method of the ionization radiation beam, it is possible that first, an ultraviolet beam is irradiated and the ionization radiation curable resin material is cured and hardened to the degree that at least on the surface, it is dried to the touch, and after that by using an electron beam radiation, it is completely cured.

[0022]

As the resin composition of the glass frit according to the present invention, it is a low melting point glass frit, and it is obtained as a heat resistant pigment material, a filler agent, are dispersed in an organic type binder. And as the low melting point glass frit, it is preferred to be a material that has a particle diameter that is in the range of 0.1 ~ 60 microns, and that has a melting point that is in the range of 400 ~ 600oC, and it is a material that has SiO2, PbO, B2O3 as its main components.

[0023]

As the above described film substrate material 2, it is a good option if a film is used that has flexibility properties and that has ionization radiation beam permeability properties, and if it is easy to be burned after the sintering, it can be used. For example, it is possible to use films that are formed from polyethylene terephthalate, polyethylene napthalate, etc., polyesters, polyethylene, polypropylene, polyvinyl chloride, polyvinylidene chloride, polycarbonate, polyamide, polyimide, polystyrene, ethylene - ethylene acetate, copolymer material, polyvinyl alcohol, etc., resins. Among those, in the case when the processing feasibility properties, the strength, the cost, etc., are considered, especially, polyester films are a good option.

[0024]

After that, the present invention will be especially explained in more details by using detailed practical implementation examples.

[0025]

<<Practical Example 1>>

As the film substrate material, polyethylene terephthalate film with a thickness of 25 microns (T-60, manufactured by Toray Company) was used, and then the shown according to the presented in Figure 1 manufacturing equipment, and the below described intaglio roll, that has an intaglio part that has regular tetragonal pyramidal shape indented part spaces, was used, and an ionization radiation curable resin composition containing a low melting point glass frit, were used. And also, under the described here below conditions, on one side of that polyester film, the cured ionization radiation curable type resin layer, that has the shape of the cell barrier part, was formed.

[0026]

Roll intaglio:

Cross sectional surface shape of the printing surface: the longitudinal cross sectional surface is a separated trapezoid.

[Figure 4 illustration]

The horizontal cross sectional surface shape has a stripe shape.

cell pitch P: 200 microns

cell groove width W: top floor - 180 microns, bottom floor - 150 microns

cell depth D: 150 microns

[0027]

Low melting point glass frit containing ionization radiation curable resin composition material

inorganic component:	silicon dioxide
lead oxide	75 weight parts
resin component:	
pentaerithritol triacrylate	22 weight parts
urethane acrylate oligomer	2 weight parts

[0028]

Radiation conditions

By using a curtain beam type electron beam radiation equipment, a 10 Mrad electron beam was irradiated.

[0028] [An error in the paragraph numbering - translator's note ?]

After that, the cell barriers that have been provided on the surface of the polyester film, obtained according to the above described, were pressure adhered on the surface of the glass substrate late used for the PDP, and after that, it is annealed under conditions where the peak temperature is 585oC and the heating time was 15 minutes, and on the PDP glass substrate late the cell barrier was formed.

[0029]

<<Practical Example 2>>

It is an example according to the Practical Example 1, where the roll intaglio, the glass frit containing ionization irradiation beam curable resin composition material, the radiation conditions were according to the described here below, and everything else was conducted the same way as described according to the Practical Example 1, and by that a cell barrier was formed on the surface of the glass substrate plate.

[0030]

Roll Intaglio:

Shape of the cross sectional surface of the printing surface: the longitudinal cross sectional surface is a separated trapezoid.

[Figure 5 reference]

The horizontal cross sectional surface shape has a square shape.

cell pitch P: 500 microns

cell groove width W: top floor - 450 microns, bottom floor - 100 microns

cell depth D: 150 microns

[0031]

Low melting point glass frit containing ionization radiation curable resin composition material

inorganic component:	silicon dioxide
silicon oxide	75 weight parts
resin component:	
pentaerithritol triacrylate	22 weight parts
urethane acrylate oligomer	2 weight parts
2-hydroxy - 2- methyl - 1- phenyl propane - 1 on (manufactured by Merck Company, Durocure 1173)	0.2 weight parts

Radiation conditions

High pressure mercury lamp, with ozone present, 160 W/cm x 2 lamps.

[0032]

[Results from the present invention]

The present invention has a structure according to the described here above, and because of that it leads to the described here below results. Because o the fact that the repeat of the printing and sintering of the cell barriers is not necessary, and the cell barriers are obtained by a one time printing and sintering, compared to the used up to this point, thick layer patterning layer lamination method using the printing method, it is possible to shorten the treatment time, and together with that it is possible to design an improvement of the accuracy of the pattern dimension and the conformity properties.

[0033]

[Detailed explanation of the figures]

[Figure 1]

Figure 1 represents a conceptual diagram showing the manufacturing method according to the present invention.

[Figure 2]

Figure 2 represents a cross sectional view diagram showing one example of the film that has the cell barriers obtained according to the manufacturing method according to the present invention.

[Figure 3]

Figure 3 represents a conceptual diagram of the cross sectional view surface of a panel that is obtained as the back surface plate with the cell barrier obtained according to the manufacturing method of the present invention, and the front surface plate, are tightly adhered.

[Figure 4]

Figure 4 is an oblique view diagram showing one example of the intaglio shape of the roll intaglio.

[Figure 5]

Figure 5 is an oblique view diagram showing one example of the intaglio shape of the roll intaglio.

[Explanation of the symbols]

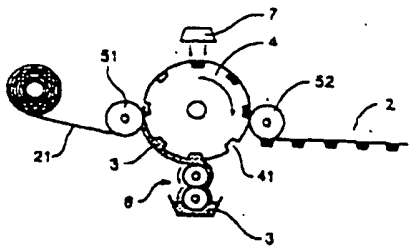
1.....cell barrier
2.....film substrate material that has the cell barriers, 21. film substrate material
22.....ionization radiation curable resin layer
3.....glass frit containing ionization radiation curable resin material
4.....roll intaglio, 41.....intaglio part, 51.....pressing pressure roll,
52.....separation (stripping) roll
6.....coating equipment
7.....ionization radiation irradiation equipment
8.....glass substrate plate

Patent Assignee: Dai Nippon Printing Company

Translated by Albena Blagev (735-1461 (h), 704-7946 (w))

【図１】

[Figure 1]

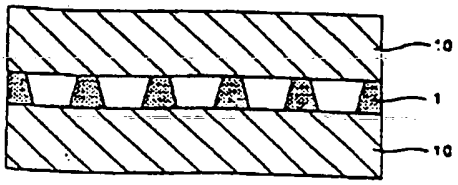


【図２】

[Figure 2]

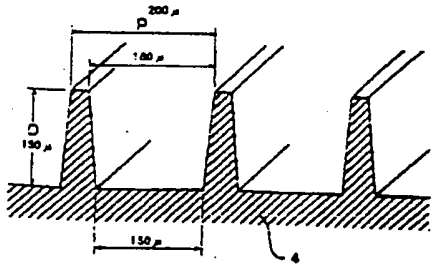
【図３】

[Figure 3]



【図４】

[Figure 4]



【図５】

[Figure 5]